

CROSS-CUTTING ISSUES

AUTHORS AND REVIEW EDITORS

Coordinating Lead Authors

Newton Paciornik (Brazil) and Kristin Rypdal (Norway)

Lead Authors

Rainer Baritz (Germany), Simon Barry (Australia), Albertus Johannes Dolman (Netherlands), Marlen Eve (USA), Michael Gillenwater (USA), Michael Kohl (Germany), Dina Kruger (USA), Bo Lim (UK/UNDP), Raisa Makipaa (Finland), Giorgio Matteucci (European Commission), Toshinori Okuda (Japan), Keith Porter (Jamaica), Maria José Sanz-Sánchez (Spain), T.P. Singh (India), Göran Ståhl (Sweden), Riccardo Valentini (Italy), and Martina Van Der Merwe (South Africa)

Contributing Authors

Sandra Brown (USA), Ketil Flugsrud (Norway), Gen Inoue (Japan), Gerald Kaendler (Germany), Anders Lindroth (Sweden), Kenlo Nishida (Japan), Steve Ogle (USA), Mats Olsson (Sweden), Gareth Philips (USA), Fran Sussman (USA), Yoshiki Yamagata (Japan), Ed Vine (USA), and Christian Wirth (Germany)

Review Editors

Jamidu Katima (Tanzania) and Tom Wirth (USA)

Contents

| | | |
|------------|--|-------------|
| 5.1 | INTRODUCTION | 5.7 |
| 5.2 | IDENTIFYING AND QUANTIFYING UNCERTAINTIES | 5.8 |
| 5.2.1 | Introduction | 5.8 |
| 5.2.2 | Methods to Combine Uncertainties | 5.10 |
| 5.2.2.1 | Tier 1 - Simple propagation of errors | 5.10 |
| 5.2.2.2 | Estimating uncertainties by category using Monte Carlo analysis (Tier 2) | 5.11 |
| 5.2.3 | Practical Considerations for Quantifying Uncertainties of Input Data..... | 5.14 |
| 5.2.4 | Example of Uncertainty Analysis | 5.16 |
| 5.2.5 | Reporting and Documentation | 5.20 |
| 5.3 | SAMPLING | 5.21 |
| 5.3.1 | Introduction | 5.21 |
| 5.3.2 | Overview on Sampling Principles | 5.21 |
| 5.3.3 | Sampling Design | 5.22 |
| 5.3.3.1 | Use of auxiliary data and stratification | 5.22 |
| 5.3.3.2 | Systematic sampling | 5.23 |
| 5.3.3.3 | Permanent sample plots and time series data | 5.23 |
| 5.3.4 | Sampling Methods for Area Estimation | 5.24 |
| 5.3.4.1 | Estimation of areas via proportions | 5.25 |
| 5.3.4.2 | Direct estimation of area | 5.25 |
| 5.3.5 | Sampling Methods for Estimating Greenhouse Gas Emissions and Removals | 5.25 |
| 5.3.6 | Uncertainties in Sample Based Surveys | 5.26 |
| 5.3.6.1 | Types of errors | 5.26 |
| 5.3.6.2 | Sample size and sampling error | 5.27 |
| 5.3.6.3 | Quantifying errors in sample based surveys | 5.28 |
| 5.4 | METHODOLOGICAL CHOICE – IDENTIFICATION OF KEY CATEGORIES | 5.29 |
| 5.4.1 | Introduction | 5.29 |
| 5.4.2 | Quantitative Approaches to Determining Key Categories | 5.29 |
| 5.4.2.1 | Tier 1 method to identify key categories of sources and sinks | 5.33 |
| 5.4.2.2 | Tier 2 method to identify key categories of sources and sinks | 5.36 |
| 5.4.3 | Qualitative Considerations | 5.38 |
| 5.4.4 | Identifying Key Categories under Kyoto Protocol Articles 3.3 and 3.4 | 5.38 |
| 5.4.5 | Application of the Results | 5.40 |
| 5.4.6 | Reporting and Documentation | 5.41 |
| 5.4.7 | Derivation of Threshold for the Tier 1 Key Category Analysis | 5.42 |
| 5.4.7.1 | Assumptions about uncertainties | 5.42 |

| | |
|--|-------------|
| 5.4.7.2 Emission level | 5.43 |
| 5.4.7.3 Trend | 5.44 |
| 5.4.8 Example of Tier 1 Key Category Analysis | 5.45 |
| 5.5 QUALITY ASSURANCE AND QUALITY CONTROL | 5.49 |
| 5.5.1 Introduction | 5.49 |
| 5.5.2 QA/QC Plan | 5.50 |
| 5.5.3 General QC Procedures (Tier 1)..... | 5.51 |
| 5.5.4 Source or Sink Category-Specific QC Procedures (Tier 2)..... | 5.52 |
| 5.5.5 QA Review Procedures | 5.53 |
| 5.5.6 Documentation, Archiving and Reporting | 5.54 |
| 5.5.7 Issues under Kyoto Protocol Articles 3.3 and 3.4 | 5.55 |
| 5.6 TIME SERIES CONSISTENCY AND RECALCULATIONS | 5.56 |
| 5.6.1 Introduction | 5.56 |
| 5.6.2 Time Series Consistency and Methodological Change | 5.56 |
| 5.6.3 Recalculation and Periodic Data | 5.58 |
| 5.6.4 Issues under Kyoto Protocol Articles 3.3 and 3.4 | 5.60 |
| 5.6.5 Reporting and Documentation | 5.60 |
| 5.7 VERIFICATION | 5.61 |
| 5.7.1 Introduction | 5.61 |
| 5.7.2 Verification Approaches | 5.62 |
| 5.7.3 Guidance for Verification of LULUCF Inventories | 5.69 |
| 5.7.4 Specific Issues Linked to the Kyoto Protocol | 5.71 |
| 5.7.5 Reporting and Documentation | 5.72 |
| 5.7.6 Some Details for Verification Approaches | 5.73 |
| References | 5.77 |

Equations

| | |
|--|------|
| Equation 5.2.1 Estimating category uncertainties (Tier 1)..... | 5.10 |
| Equation 5.2.2 Overall uncertainty in national emissions (Tier 1)..... | 5.11 |
| Equation 5.4.1 Level assessment (Tier 1)..... | 5.33 |
| Equation 5.4.2 Trend assessment (Tier 1) | 5.34 |
| Equation 5.4.3 Trend assessment with zero current year emissions | 5.35 |
| Equation 5.4.4 Level assessment (Tier 2)..... | 5.37 |
| Equation 5.4.5 Trend assessment (Tier 2) | 5.37 |

Figures

| | |
|--|------|
| Figure 5.3.1 Principle of sampling | 5.21 |
| Figure 5.3.2 Simple random layout of plots (left) and systematic layout (right) | 5.23 |
| Figure 5.3.3 Use of different configurations of permanent and temporary sampling units for estimating changes | 5.24 |
| Figure 5.3.4 Relationship between the standard error of the area estimate, $s(A)$, the proportion of the land-use class, p , and the sample size, n | 5.27 |
| Figure 5.4.1 Decision tree to identify key categories of sources and sinks | 5.30 |
| Figure 5.4.2 Decision tree to choose a good practice method | 5.41 |
| Figure 5.4.3 Cumulative uncertainty plotted against cumulative emissions | 5.43 |
| Figure 5.4.4 Fraction of emissions required to reach 90% of sum of contribution from uncertainties in different inventories. With and without LULUCF | 5.43 |
| Figure 5.4.5 Fraction of emissions required to reach 90% of sum of contribution from trend uncertainty in different inventories. With and without LULUCF | 5.44 |
| Figure 5.6.1 Recalculated estimate for 2003 based on linear extrapolation | 5.59 |

Tables

| | | |
|-------------|---|------|
| Table 5.3.1 | Example of area estimation via proportions | 5.25 |
| Table 5.4.1 | Suggested IPCC source/sink categories for LULUCF and non-LULUCF | 5.31 |
| Table 5.4.2 | Spreadsheet for the Tier 1 analysis – Level assessment including LULUCF categories | 5.34 |
| Table 5.4.3 | Spreadsheet for the Tier 1 analysis – Trend assessment including LULUCF categories | 5.35 |
| Table 5.4.4 | Relationship between activities identified in Chapter 3 and Chapter 4 and IPCC source/sink categories for LULUCF | 5.39 |
| Table 5.4.5 | Key category analysis summary | 5.42 |
| Table 5.4.6 | Assumed uncertainties to determine a key category threshold including LULUCF | 5.42 |
| Table 5.4.7 | Example of a level assessment for an Annex I country | 5.45 |
| Table 5.4.8 | Trend analysis with LULUCFs | 5.47 |
| Table 5.5.1 | Tier 1 general inventory level QC procedures | 5.51 |
| Table 5.6.1 | Summary of approaches to obtain consistency in time series | 5.57 |
| Table 5.7.1 | Applicability of verification approaches for land area identification and for carbon pools and non-CO ₂ greenhouse gases | 5.63 |
| Table 5.7.2 | Features of some of the main remote sensing platforms | 5.76 |

Boxes

| | | |
|-----------|--|------|
| Box 5.2.1 | Example of uncertainty expression | 5.9 |
| Box 5.2.2 | Level of aggregation of the Tier 1 analysis | 5.11 |
| Box 5.2.3 | Tier 2 uncertainty assessment for changes in agricultural soil C in the U.S.A | 5.14 |
| Box 5.2.4 | Uncertainties of estimates based on models | 5.16 |
| Box 5.5.1 | Definitions of Quality Assurance and Quality Control | 5.49 |
| Box 5.5.2 | Expert peer review | 5.54 |
| Box 5.6.1 | Example case where a national forest inventory is conducted every 5 years | 5.58 |
| Box 5.6.2 | Example of modelling the emissions of a site over time | 5.59 |
| Box 5.7.1 | Definition of verification for the inventory | 5.61 |
| Box 5.7.2 | Guidance for selecting inventory components for verification and verification approaches | 5.69 |
| Box 5.7.3 | Verification of LULUCF Sector in a National Inventory | 5.70 |
| Box 5.7.4 | Guidance for verifying carbon pools and activities | 5.71 |
| Box 5.7.5 | Verification of LULUCF under the Kyoto Protocol | 5.72 |
| Box 5.7.6 | Programs/networks relevant to LULUCF | 5.73 |